

LOWER EXTREMITIES

PATHOLOGY

1.) Congenital Clubfoot

- Talipes equinovarus
- Abnormal twisting of the foot usually inward & downward

2.) Pott's Fx

- Avulsion fx of the medial malleolus with loss of the ankle mortise

3.) Jones Fx

- Avulsion fx of the base of the fifth metatarsal

4.) Gout

- Hereditary form of arthritis in which uric acid is deposited in joints

5.) Osgood-Schlatter Disease

- Incomplete separation or avulsion of the tibial tuberosity

6.) Giant Cell Tumor

- Osteoclastoma
- Lucent lesion in the metaphysis usually at the distal femur

7.) Chondromalacia Patellae

- Runner's knee
- Softening of the cartilage under the patella

8.) Joint Effusion

- Accumulation of fluid in the joint cavity

9.) Lisfranc Injury

- Abnormal separation in the base of 1st & 2nd metatarsal & cuneiform

10.) Reiter Syndrome

- Erosions of sacroiliac joints & lower limbs

11.) Hallux Valgus

- Congenital abnormality of hallux
- Lateral deviation of great toe

ROUTINE

1.) Bony Injuries – AP, APO & Lateral

2.) Bony Pathology – AP & APO

3.) Foreign Body Localization – AP & Lateral

DIVISIONS OF FOOT

1.) Hindfoot – calcaneus & talus

2.) Midfoot – cuboid, navicular & cuneiform

3.) Forefoot – metatarsals & phalanges

A.) TOES

AP/AP AXIAL PROJECTION

PP: Supine/Seated; knee flexed; 15° foam wedge under foot

RP: 3rd MTP joint

CR: ⊥ or 15° posteriorly

SS: Phalanges & distal portion of metatarsals

AP Axial (15°): Open IP joints & reduces shortening

PA PROJECTION

PP: Prone (IP joints // to CR); dorsal aspect against IR

RP: 3rd MTP joint

CR: ⊥

SS: IP joint spaces are well visualized

AP OBLIQUE PROJECTION

Medial Rotation

PP: Supine/seated; knee flexed; lower leg & foot rotated medially 30-45°;

RP: 3rd MTP joint

CR: ⊥

SS: 2nd-5th MTP joint spaces; 1st-3rd toes

Lateral Rotation

PP: Supine/seated; knee flexed; lower leg & foot rotated medially 30-45°;

RP: 3rd MTP joint

CR: ⊥

SS: 3rd-5th toes

LATERAL PROJECTION

PP: Lateral recumbent; toe in true lateral

RP: IP joint (1st toe); proximal IP joint (2nd-4th toes)

CR: ⊥

SS: Phalanges in profile; open IP joints spaces

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B.) SESAMOIDS

LEWIS METHOD

TANGENTIAL PROJECTION

PP: Prone; dorsiflex great toe; ankle elevated; ball of foot \perp IR

RP: 1st MTP joint

CR: Perpendicular

SS: MT head & sesamoids in profile

HOLLY METHOD

TANGENTIAL PROJECTION

PP: Seated; plantar 75° to IR; toe flexed & hold w/ strip gauze bandage; foot medial border \perp to IR

RP: 1st MTP head

CR: \perp

SS: MT head & sesamoids in profile

CAUSTON METHOD

TANGENTIAL PROJECTION

PP: Lateral recumbent; patient lie against unaffected side; limb partially extended; foot in lateral position; 1st MTP joint \perp to IR

RP: Prominence of 1st MTP joint

CR: 40° toward the heel

SS: Sesamoids with slight overlap

C.) FOOT

AP/AP AXIAL PROJECTION

PP: Supine; knee flexed; plantar surface against IR

RP: 3rd MTP base

CR: \perp or 10° posteriorly

SS: MT & Tarsal (\perp); TMT joint (10°)

ER:

- For localizing foreign bodies
- Location of fragments in fx of metatarsals & anterior tarsals
- General surveys of the foot

10° Angulation: reduces foreshortening of metatarsals

AP OBLIQUE PROJECTION

Medial Rotation

PP: Supine; knee flexed; leg rotated medially; plantar surface of foot 30° to IR

RP: 3rd MTP base

CR: \perp

SS:

- Cuboid
- Interspaces on lateral side of foot
- Sinus tarsi
- Lateral cuneiform
- 3rd-5th MT bases
- 5th MT tuberosity

Lateral Rotation

PP: Supine; knee flexed; leg rotated laterally; plantar surface of foot 30° to IR

RP: 3rd MTP base

CR: \perp

SS:

- Navicular
- Interspaces on medial side of foot
- Medial & intermediate cuneiform
- 1st-2nd MT bases

LATERAL PROJECTION

Mediolateral

PP: Dorsiflex foot (\perp to lower leg); leg & foot in lateral position; lateral side of foot against IR (more comfortable)

RP: 3rd MT base

CR: Perpendicular

SS: Entire foot in profile

ER:

- For localizing foreign body
- Degree of anterior & posterior displacement of fx

Lateromedial

PP: LPO/RPO; medial surface against IR; plantar surface of foot \perp to IR

RP: 3rd MTP base

CR: Perpendicular

LOWER EXTREMITIES

SS: True lateral projection of foot

WEIGHT-BEARING METHOD

LATERAL PROJECTION

PP: Upright; feet elevated (use blocks); IR b/n feet; weight equally distributed on each foot

RP: Point above 3rd MTP base

CR: Horizontal

SS: Status of longitudinal arch (pes planus);

Bohler's critical angle (20-40°)

Bohler's Critical Angle: angle b/n superior apex of mid-calcaneus to anterior process of calcaneus

WEIGHT-BEARING METHOD

AP AXIAL PROJECTION

PP: Upright; both feet against IR; weight equally distributed on each foot

RP: b/n feet at 3rd MTP base level

CR: 10° or 15° posteriorly

SS: Accurate evaluation & comparison of MT & tarsals

- Hallux valgus & lishfranc injury

WEIGHT-BEARING COMPOSITE METHOD

AP AXIAL PROJECTION

PP: Upright; 2 exposures

- **First Exposure:** opposite foot step backward (for forefoot); tube in front
- **Second Exposure:** opposite foot step backward (for hindfoot); tube behind

RP: 3rd MTP base (1st exposure); level of lateral malleolus (2nd exposure)

CR: 15° posteriorly (1st exposure); 25° anteriorly (2nd exposure)

SS: Full outline of the foot

D.) CONGENITAL CLUBFOOT

KITE METHOD

AP PROJECTION

PP: Supine; hips & knees flexed; foot flat on IR; ankles slightly extended; legs are vertical

RP: Tarsals

CR: 15° posteriorly

SS:

- True relationship of bones & ossification centers of tarsals
- Degree of forefoot adduction & calcaneus inversion

15° Angulation: places CR \perp to tarsals

KITE METHOD

LATERAL PROJECTION

Mediolateral

PP: Lateral recumbent; uppermost limb flexed & draw forward

RP: Midtarsal area

CR: Perpendicular

SS:

- Anterior talar subluxation
- Degree of plantar flexion (equinus)

KANDEL METHOD

DORSOPLANTAR AXIAL PROJECTION

PP: Bending forward position; plantar surface against IR

RP: Lower leg

CR: 40° anteriorly

SS: Calcaneus

Freiberger-Hersh-Harrison: CR 35°, 45° & 55° for demonstration of sustentaculum talar joint

E.) CALCANEUS

AXIAL PROJECTION

Plantodorsal

PP: Supine/Seated; leg fully extended; dorsiflex foot w/ strip of gauze; foot \perp to IR

RP: 3rd MT base

CR: 40° cephalad

SS: Calcaneus & subtalar joint

Dorsoplantar

PP: Prone; ankle elevated; dorsiflex ankle; foot \perp to IR; IR vertical

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RP: Dorsal surface of ankle joint

CR: 40° caudad

SS: Calcaneus, subtalar joint & sustentaculum tali

LILIENFELD METHOD

WEIGHT-BEARING COALITION

DORSOPLANTAR AXIAL PROJECTION

PP: Upright; posterior surface of heel at edge of IR; opposite foot one step forward

RP: Level of 5th MT base

CR: 45° anteriorly

SS: Calcaneotalar coalition

LATERAL PROJECTION

Mediolateral

PP: Supine; patient turn toward affected side; plantar surface // to IR

RP: 1 in distal to medial malleolus

CR: ⊥

SS: Calcaneus & ankle joint

WEIGHT BEARING METHOD

LATEROMEDIAL OBLIQUE PROJECTION

PP: Upright; leg perpendicular to IR; calcaneus center to IR

RP: Lateral malleolus

CR: 45° caudad (medially)

SS: Calcaneal tuberosity

ER: Useful in diagnosing stress fractures of calcaneus or tuberosity

F.) SUBTALAR JOINT

ISHERWOOD METHOD

LATEROMEDIAL OBLIQUE PROJECTION

Medial Rotation Foot

PP: Semisupine; foot & leg rotated 45° medially; knee flexed

RP: 1 in. distal & 1 in. anterior to lateral malleolus

CR: ⊥

SS: Anterior subtalar articulation

ISHERWOOD METHOD

AP AXIAL OBLIQUE PROJECTION

Medial Rotation Ankle

PP: Seated or semi-lateral recumbent (more comfortable); leg, foot & ankle rotated 30° medially; dorsiflex foot

RP: 1 in. distal & 1 in. anterior to lateral malleolus

CR: 10° cephalad

SS: Middle subtalar articulation & “end on” projection of sinus tarsi

Lateral Rotation Ankle

PP: Supine/seated; leg, foot & ankle rotated 30° laterally; dorsiflex foot

RP: 1 in. distal medial malleolus

CR: 10° cephalad

SS: Posterior subtalar articulation

BRODEN METHOD

AP AXIAL OBLIQUE PROJECTION

Medial Rotation

PP: Supine; leg & foot rotated 45° medially; dorsiflex foot; foot rested against 45° foam wedge

RP: 2-3 cm to lateral malleolus

CR: 10°, 20°, 30° or 40° cephalad

SS: Posterior articulation

- Anterior portion (40°)
- Posterior portion (10°)
- Talus & sustentaculum tali articulation (20-30°)

Lateral Rotation

PP: Supine; leg & foot rotated 45° laterally; dorsiflex foot; foot rested against 45° foam wedge

RP: 2 cm distal & 2 cm anterior to medial malleolus

CR: 15° cephalad

SS: Posterior articulation

ER: To determine the presence of joint involvement in cases of comminuted fx

LOWER EXTREMITIES

G.) ANKLE

AP PROJECTION

PP: Supine; leg & foot vertical & rotated 5° medially (places malleoli equidistant)

RP: Point midway between malleoli

CR: ⊥ to ankle joint

SS: Ankle joint & tibiotalar joint space

LATERAL PROJECTION

Mediolateral

PP: Semisupine; lateral surface of foot against IR; dorsiflex foot

RP: Medial malleolus

CR: ⊥ to ankle joint

SS: True lateral projection of lower third of tibia & fibula, ankle joint & tarsals

- 5th metatarsal base (identify Jones fx)

Lateromedial

PP: Semisupine; medial surface of foot against IR; dorsiflex foot

RP: 0.5 in. superior to lateral malleolus

CR: ⊥ to ankle joint

SS: Lateral projection of lower third of tibia & fibula, ankle joint & tarsals

AP OBLIQUE PROJECTION

Medial Rotation

PP: Supine;

- Leg & foot rotated 45° medially; dorsiflex foot – to demonstrate bony structure
- Leg & foot rotated 15-20° medially; intermalleolar line // to IR – to demonstrate mortise joint

RP: Point midway b/n malleoli

CR: ⊥ to ankle joint

SS: Distal ends of tibia, fibula & talus; tibiofibular articulation; mortise joints

Lateral Rotation

PP: Supine; leg & foot rotated 45° laterally; dorsiflex foot

RP: Point midway b/n malleoli

CR: ⊥ to ankle joint

SS: Superior aspect of calcaneus

ER: Useful in determining fx

STRESS METHOD

AP PROJECTION

PP: Seated; foot forcibly turned toward the opposite side; inversion & eversion stress to joint

RP: Ankle joint

CR: ⊥

ER: To evaluate the presence of ligamentous tear & joint separation

WEIGHT-BEARING METHOD

AP PROJECTION

PP: Upright; heels against the IR; IR vertical; toes pointing toward the x-ray tube

RP: Midway at level of ankle joint

CR: Horizontal

ER: Identify ankle joint space narrowing; side-to-side comparison of joint

H.) LEG

AP PROJECTION

PP: Supine; femoral condyles // to IR; foot in vertical position;

RP: Midshaft

CR: ⊥

SS: Tibia & fibula; ankle & knee joints

LATERAL PROJECTION

MEDIOLATERAL

PP: Supine; RPO/LPO; patella ⊥ to IR; femoral condyles ⊥ to IR;

RP: Midshaft

CR: ⊥

SS: Tibia & fibula; ankle & knee joints

AP OBLIQUE PROJECTION

PP: Supine; leg & foot rotated 45° medially or laterally

LOWER EXTREMITIES

RP: Midshaft

CR: \perp

SS: Tibia & fibula; ankle & knee joints

L.) KNEE

AP PROJECTION

PP: Supine; femoral epicondyles // to IR; leg 5° inward (places interepicondylar line // to IR)

RP: 0.5 in. inferior to patellar apex

CR: depending on the measurement b/n ASIS & table top

- 3-5° caudad (<19 cm; thin pelvis)
- \perp (19-24 cm)
- 3-5° cephalad (>24 cm; large pelvis)

SS: Knee joint space

PA PROJECTION

PP: Prone; femoral epicondyles // to IR; leg 5° inward (places interepicondylar line // to IR)

RP: 0.5 in. inferior to patellar apex

CR: 5-7° caudad

SS: Knee joint space

LATERAL PROJECTION

Mediolateral

PP: Lateral recumbent; knee flexed 20-30° (relax muscle & shows maximum volume of joint cavity) or flexed <10° (for new or unhealed patellar fx); femoral epicondyles \perp to IR

RP: 1 in. distal to medial epicondyle

CR: 5-7° cephalad

SS: Knee joint space

AP OBLIQUE PROJECTION

Medial Rotation

PP: Supine; leg rotated 45° medially; hip of affected side elevated

RP: 0.5 in. inferior to patellar apex

CR: depending on the measurement b/n ASIS & table top

- 3-5° caudad (<19 cm)

- Perpendicular (19-24 cm)

- 3-5° cephalad (>24 cm)

SS: Proximal tibiofibular joint; fibular head

Lateral Rotation

PP: Supine; leg rotated 45° medially; hip of unaffected side elevated

RP: 0.5 in inferior to patellar apex

CR: 5° cephalad

SS: Tibial plateaus; medial femoral & tibial condyles

WEIGHT-BEARING METHOD

AP BILATERAL PROJECTION

LEACH-GREGG-SIBER

PP: Upright; knee fully extended; weight equally distributed on both feet; IR vertical

RP: 0.5 in. inferior to patellar apex

CR: Horizontal

SS: Knee joint spaces

ER:

- To reveal narrowing of knee joint space
- To evaluate varus & valgus deformities & degenerative joint disease

ROSENBERG METHOD

PA WEIGHT-BEARING

STANDING FLEXION

PP: Upright; facing vertical IR; anterior surface of flexed knee against IR; femur 45° to IR

RP: 0.5 in. inferior to patellar apex

CR: Horizontal or 10° caudad

ER: Useful for evaluating joint space narrowing & demonstrating articular cartilage disease

J.) INTERCONDYLAR FOSSA

HOLMBLAD METHOD

PA AXIAL PROJECTION

TUNNEL VIEW

PP: Anterior surface of knee against IR; knee 60-70° from IR (20° difference from CR)

3 positions:

LOWER EXTREMITIES

- Standing; knee flexed & rested on a stool
- Standing at side of table; knee flexed & rested over the IR
- Kneeling on table; knee over the IR (Holmblad Method)

RP: Popliteal depression

CR: \perp

SS: Intercondylar fossa

CAMP-COVENTRY METHOD

PA AXIAL PROJECTION

PP: Prone; knee flexed 40-50° from IR; femur against IR; with support under foot

RP: Popliteal depression

CR: 40° (knee flexed 40°) or 50° (knee flexed 50°) caudally

SS: Intercondylar fossa

ER:

- To detect loose bodies "joint mice"
- To evaluate split & displaced cartilage in osteochondritis
- To evaluate flattening or underdevelopment of lateral femoral condyles in congenital slipped patella

BECLERE METHOD

AP AXIAL PROJECTION

PP: Supine; knee flexed; femur 60° to long axis of tibia; curved cassette is used

RP: 0.5 in. inferior to patellar apex

CR: \perp to long axis of lower leg

SS: Intercondylar fossa, intercondylar eminence, knee joint & tibial plateau

K.) PATELLA

PA PROJECTION

PP: Prone; heel 5-10° laterally (places patella // to IR)

RP: Midpopliteal depression

CR: Perpendicular

SS: Sharper image of patella (closer OID)

LATERAL PROJECTION

PP: Lateral recumbent; unaffected knee & hip flexed; unaffected foot in front; affected knee flexed 5-10° or flexed not >10° (for new or unhealed patellar fx); femoral epicondyles & patella \perp to IR;

RP: Midpatellofemoral joint

CR: \perp

SS: Patella & patellofemoral joint space

PA OBLIQUE PROJECTION

Medial Rotation

PP: Prone; knee flexed 5-10°; knee 45-55° medially

RP: Patella

CR: \perp

SS: Medial portion of patella free of femur

Lateral Rotation

PP: Prone; knee flexed 5-10°; knee 45-55° laterally

RP: Patella

CR: \perp

SS: Lateral portion of patella free of femur

KUCHENDORF METHOD

PA AXIAL OBLIQUE PROJECTION

Lateral Rotation

PP: Prone; hip elevated 2-3 in.; knee flexed 10° (relax the muscles); knee rotated 35-40° laterally

RP: Joint space b/n patella & femoral condyles

CR: 25-30° caudad

SS: Oblique patella free superimposition of femur

HUGHSTON METHOD

TANGENTIAL PROJECTION

PP: Prone; anterior surface of knee against IR; knee flexed 50-60°; foot rested against collimator/support

RP: Patellofemoral joint

CR: 45° cephalad

SS: Patella; patellofemoral joint

ER:

- To demonstrate subluxation of patella & patellar fx

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- It allows assessment of femoral condyles

MERCHANT METHOD

TANGENTIAL PROJECTION

PP: Supine; both knee flexed 40° or b/n 30-90° (to demonstrate various patellar disorders); IR resting on patient's shins; uses IR holding device & axial viewer device

RP: Midway b/n patellae at level of patellofemoral joint

CR: 30° caudad from horizontal

SS: Femoral condyle; intercondylar sulcus & magnified nondistorted patellae

SETTEGAST METHOD

TANGENTIAL PROJECTION

Disadvantage: Extreme flexion

PP: Supine or prone (preferable); knee acutely flexed until patella ⊥ to IR; loop bandage around ankle or foot to hold the leg in position

RP: Joint space b/n patella & femoral condyles

CR: Perpendicular (if joint is ⊥); 15-20° cephalad (if joint isn't ⊥)

- Angulation depends on knee flexion

SS: Patella; patellofemoral joint

ER:

- Useful for demonstrating vertical & transverse fx of patella
- Useful for investigating articulating surfaces of patellofemoral articulation

SUNRISE METHOD

TANGENTIAL PROJECTION

MOUNTAIN/SKYLINE VIEW

PP: Supine/Sitting; knee flexed 40-45°

RP: Patellofemoral joint

CR: 30° from horizontal

ER: Joint space b/n patella & femoral condyles

L.) FEMUR

AP PROJECTION

PP: Supine

- **Distal femur (knee included):** leg rotated 5° inward (places limb in true anatomic position)
- **Proximal femur (hip included):** leg rotated 10-15° inward (places femoral neck in profile)

RP: Midfemur

CR: ⊥

SS: Femoral neck & hip joint (10-15°); knee joint (5°)

LATERAL PROJECTION

Mediolateral

PP: Lateral recumbent; affected side against IR

- **Distal femur (knee included):** unaffected limb draw forward; pelvis in true lateral position; affected knee flexed 45°; femoral epicondyles ⊥ to IR;
- **Proximal femur (hip included):** unaffected limb draw posteriorly; pelvis rolled 10-15° posteriorly

RP: Midfemur

CR: ⊥

SS: ¾ of femur & adjacent joints

TRANSLATERAL PROJECTION

CROSSTABLE LATERAL

PP: Dorsal decubitus; IR placed vertically against medial/lateral surface of femur;

RP: Medial side of midfemur

CR: Horizontal

SS: Entire femur & knee joint

ER: For patient who can't tolerate routine lateral position because of fractures or destructive disease

☺ THE END ☺

“BOARD EXAM is a matter of PREPARATION. If you FAIL to prepare, you PREPARE to fail”

03/24/14